

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **LAKE WINNISQUAM, THREE ISLAND** the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- Figure 1: These graphs illustrate concentrations of chlorophyll-a in the water column. Algae are microscopic plants that are a natural part of lake ecosystems. Algae contain chlorophyll-a, a pigment necessary for photosynthesis. A measure of chlorophyll-a can indicate the abundance of algae in a lake. The historical data (the bottom graph) show a *very stable* in-lake chlorophyll-a trend. The chlorophyll concentration was back to normal for the Three Island station after the increase in 1998. Overall, chlorophyll concentration has remained below the NH mean since 1987! We recommend increased sampling frequency of once per month in the summer. This will enable a more accurate trend analysis. While algae are present in all lakes, an excess amount of any type is not welcomed. Concentrations can increase when there are internal and external sources of phosphorus, which is the nutrient algae depend upon for growth. It's important to continue the education process and keep residents aware of the sources of phosphorus and how it influences lake quality.
- Figure 2: Water clarity is measured by using a Secchi disk. Clarity, or transparency, can be influenced by such things as algae, sediments from erosion, and natural colors of the water. The graphs on this page show historical and current year data. The lower graph shows a *slightly improving* trend in lake transparency, and the reading was again above the state mean. Water clarity has not been this high since 1996! We hope to see this high reading continue in the 2001 sampling season. However, the transparency was only measured once during the summer. With increased sampling, we will be able to determine the actual mean transparency at this station. The 2000 sampling season was considered to be wet and, therefore, average transparency readings are expected to be slightly lower than last year's readings. Higher amounts of rainfall usually cause more eroding of sediments into the lake and streams, thus decreasing clarity.

- Figure 3: These figures show the amounts of phosphorus in the epilimnion (the upper layer in the lake) and the hypolimnion (the lower layer); the inset graphs show current year data. Phosphorus is the limiting nutrient for plants and algae in New Hampshire waters. Too much phosphorus in a lake can lead to increases in plant growth over time. These graphs show a *variable* trend for in-lake phosphorus levels. Phosphorus concentration in both layers of the lake increased from the 1998 season. Sampling more frequently during the summer months will yield more data points, which will allow us to better understand the trend in phosphorus for the Three Island station. Phosphorus concentration has remained below the NH median since 1987 in the epilimnion, and 1988 in the hypolimnion. One of the most important approaches to reducing phosphorus levels is educating the public. Humans introduce phosphorus to lakes by several means: fertilizing lawns, septic system failures, and detergents containing phosphates are just a few. Keeping the public aware of ways to reduce the input of phosphorus to lakes means less productivity in the lake. Contact the VLAP coordinator for tips on educating your lake residents or for ideas on testing your watershed for phosphorus inputs.

OTHER COMMENTS

- Dissolved oxygen was again high at all depths of the lake (Table 9). As stratified lakes age, oxygen is depleted in the lower layer by the process of decomposition. The lack of this aging indicator is a sign of the lake's overall health.
- Conductivity in Collins Bk. increased from the 1998 season (Table 6). It was noted that the water was stagnant when tested, and salts and minerals tend to accumulate in stagnant waters. This accumulation often leads to increases in conductivity.
- Phosphorus concentration in Collins and Mill Brooks decreased from the increase observed in 1998 (Table 8). This is a positive sign for the lake, and we hope that this continues. Sources of phosphorus to lakes can include fertilizers, detergents, sandy beaches, septic system leachate, and agricultural runoff.
- *E. coli* originates in the intestines of warm-blooded animals (including humans) and is an indicator of associated and potentially harmful pathogens. Bacteria concentrations were elevated in Governor Park Stream in August (Table 12). Since there has been concern about septic impacts from the prison, we suggest monitoring the stream at least once per month in the summer (if there is sufficient flow for a clean sample), and after rain events. We also suggest testing for phosphorus and conductivity, since these tests can also help indicate septic system leachate. If you would like to conduct these tests please call the VLAP Coordinator at 271-2658 so that extra bottles can be brought or sent to the lake.

- The blue-green algae *Aphanizomenon* and *Coelosphaerium* were identified in small amounts in the plankton sample in August. Blue-green algae can reach nuisance levels when sufficient nutrients and favorable environmental conditions are present. While overall algae abundance continues to be low in the lake, the presence of these indicator species should serve as a reminder of the lake's delicate balance. Continued care to protect the watershed by limiting or eliminating fertilizer use on lawns, keeping the lake shoreline natural, and properly maintaining septic systems and roads will keep algae populations in balance.

NOTES

- Monitor's Note (8/18/00): Collins Brook pretty stagnant.
- Biologist's Note (8/18/00): Mill Brook turbidity not run due to error in lab.

USEFUL RESOURCES

Stormwater Management and Erosion and Sediment Control Handbook. NHDES, Rockingham County Conservation District, USDA Natural Resource Conservation Service, 1992. (603) 679-2790.

Bacteria in Surface Waters, WD-BB-14, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, WD-BB-9, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Septic Systems and Your Lake's Water Quality, WD-BB-11, NHDES Fact Sheet, (603) 271-3503 or www.state.nh.us

Vegetated Phosphorus Buffer Strips, NH Lakes Association pamphlet, (603) 226-0299 or www.nhlakes.org

Clean Water in Your Watershed. Terrene Institute, 1993. (800) 726-5253, or www.terrene.org

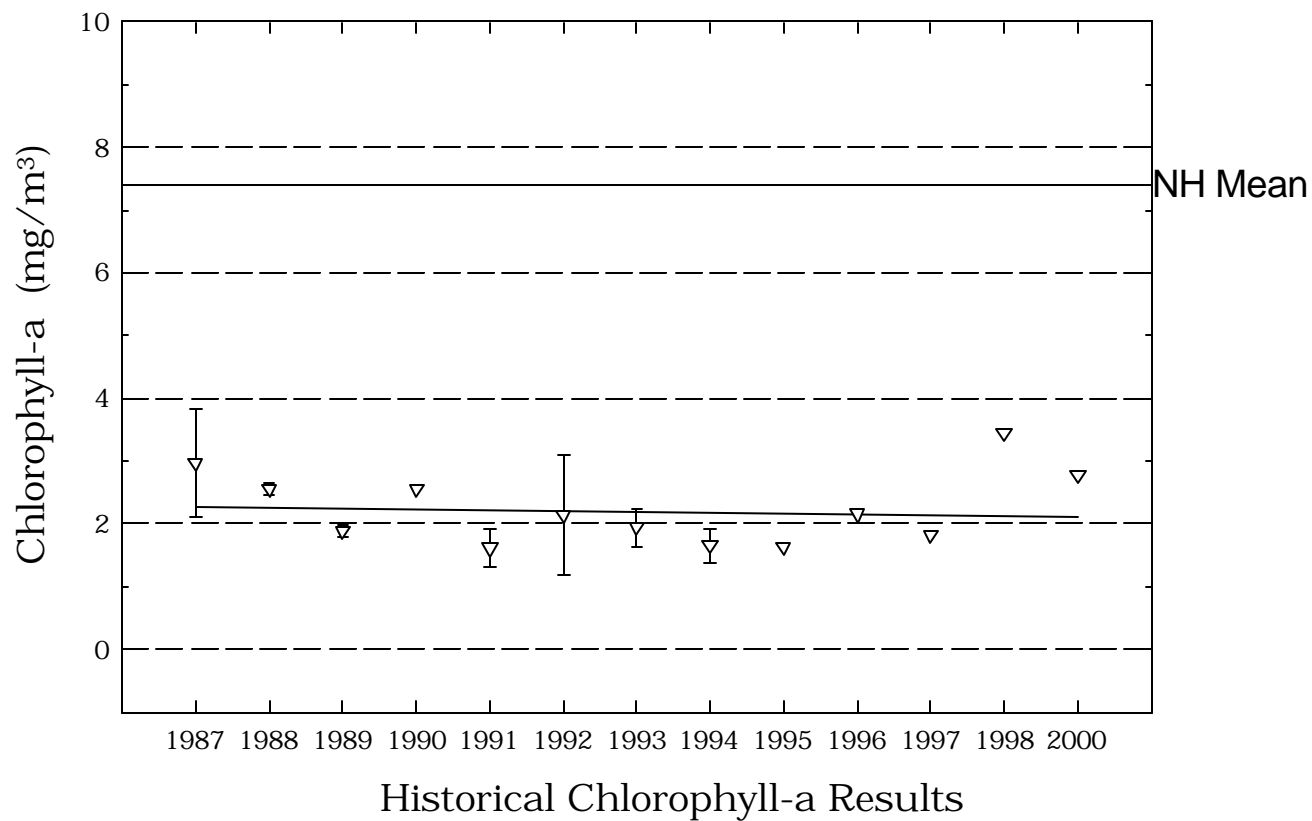
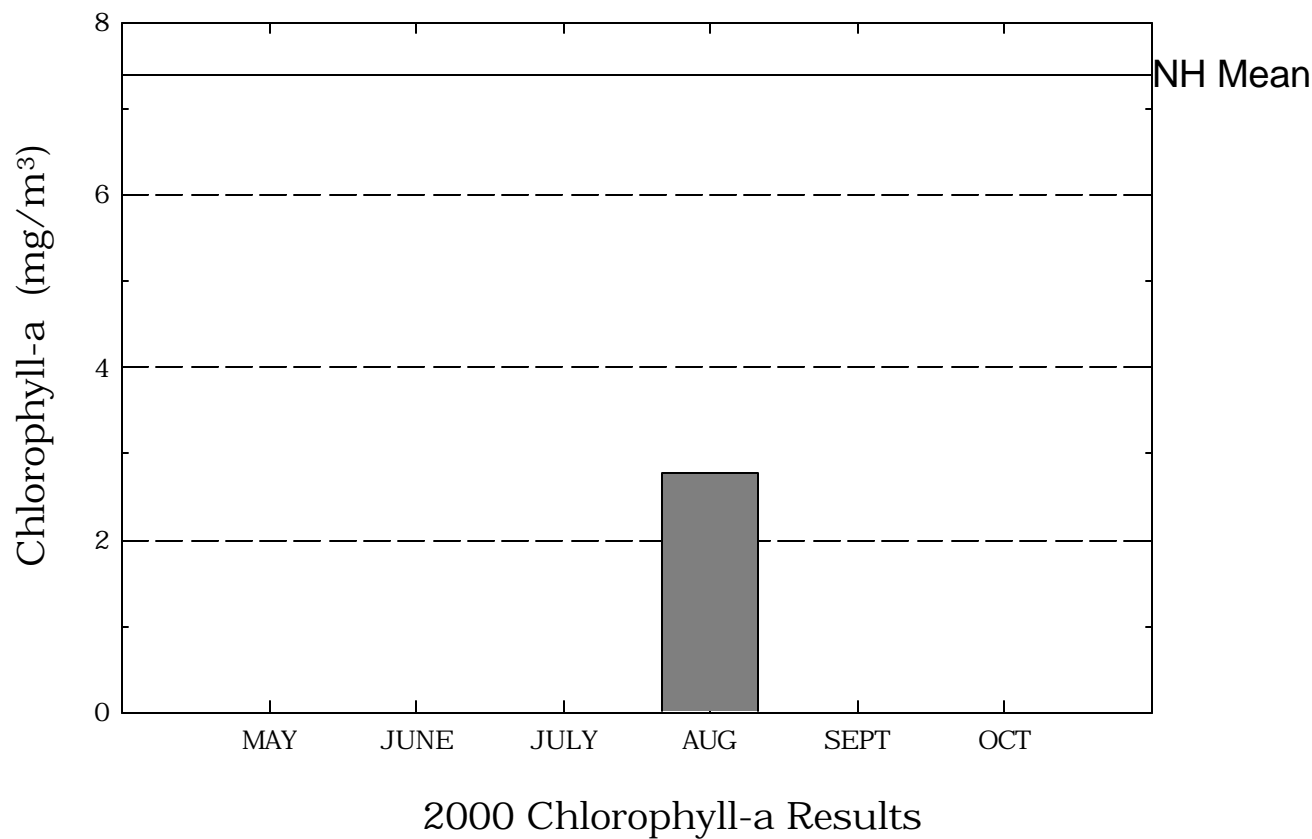
Nonpoint Source Pollution and Stormwater Fact Sheet Package. Terrene Institute. (800) 726-5253, or www.terrene.org

The Watershed Guide to Cleaner Rivers, Lakes, and Streams, Connecticut River Joint Commissions, 1995. (603) 826-4800

The Blue Green Algae. North American Lake Management Society, 1989. (608) 233-2836 or www.nalms.org

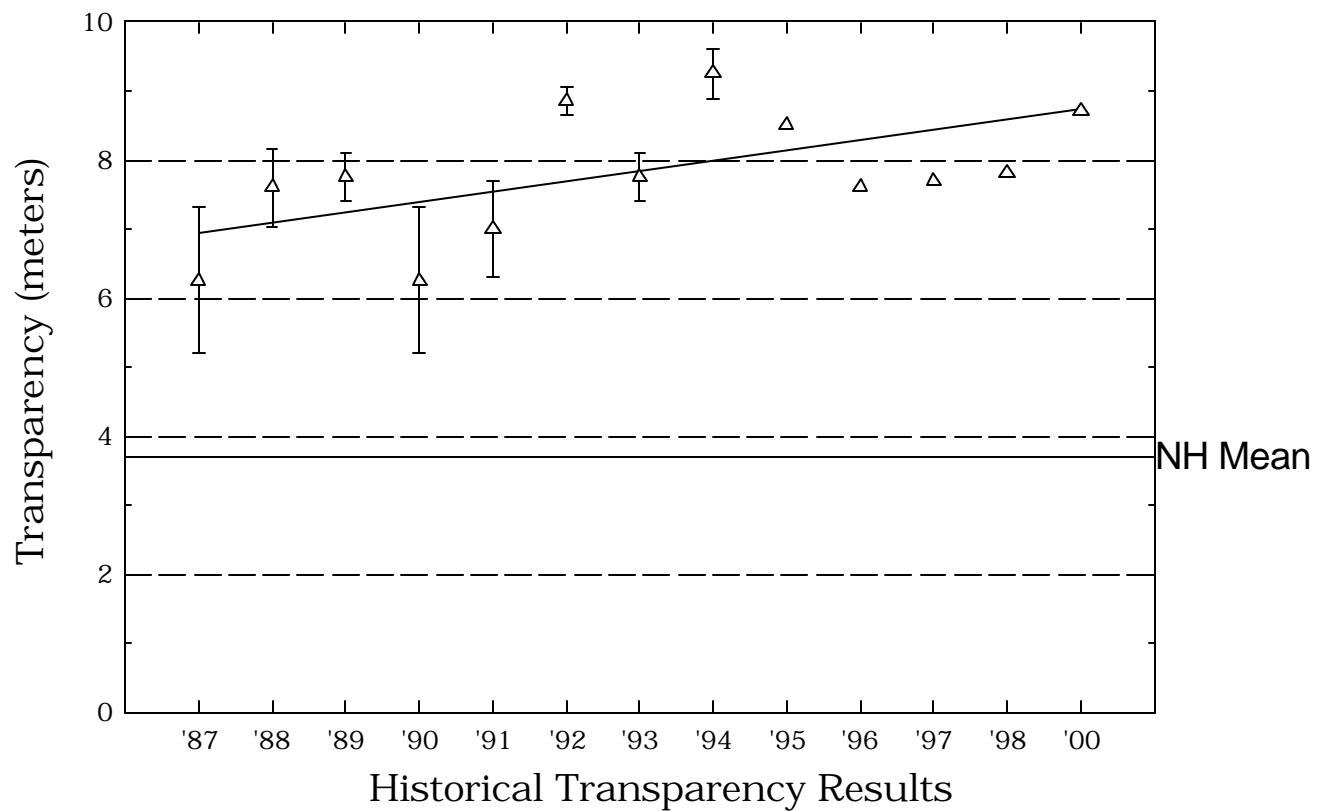
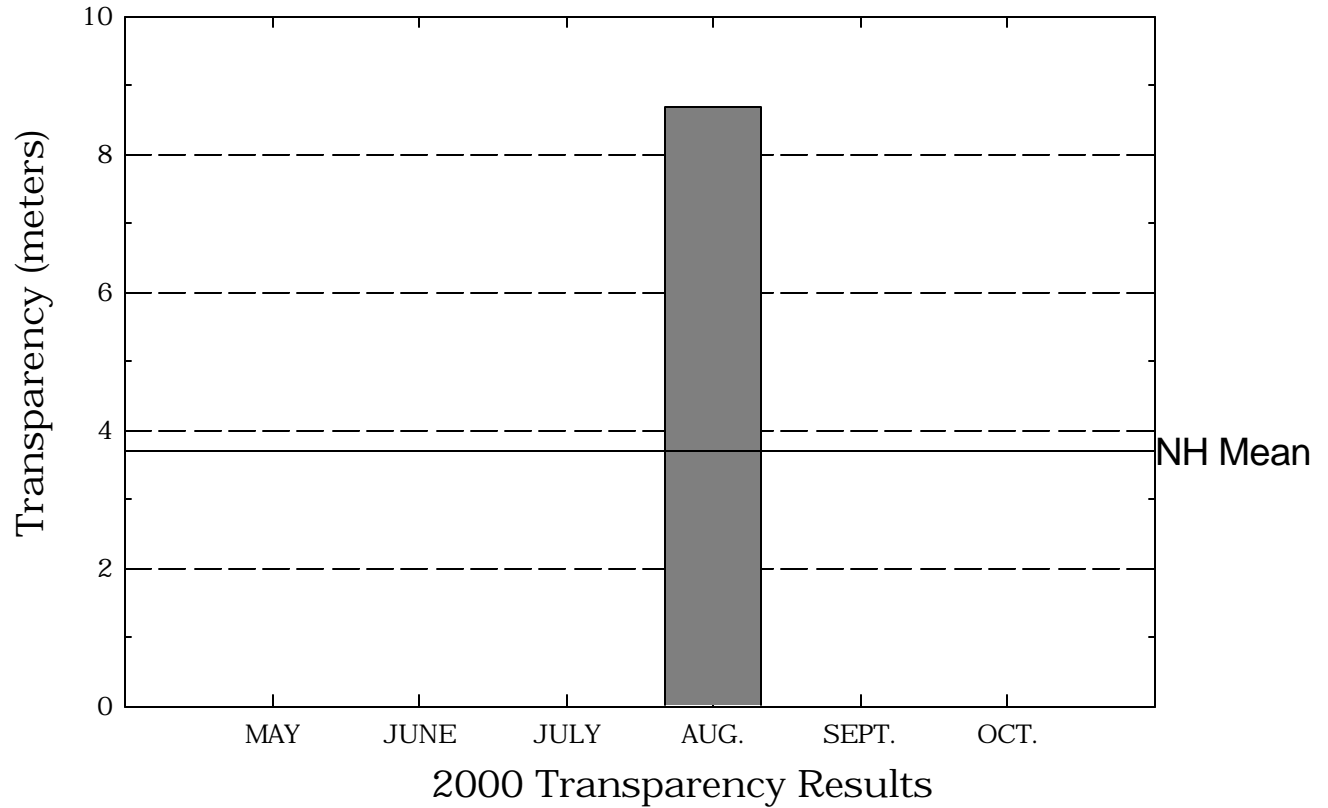
Lake Winnisquam, Three Island

Figure 1. Monthly and Historical Chlorophyll-a Results



Lake Winnisquam, Three Islands

Figure 2. Monthly and Historical Transparency Results



Lake Winnisquam, Three Island

Figure 3. Monthly and Historical Total Phosphorus Data.

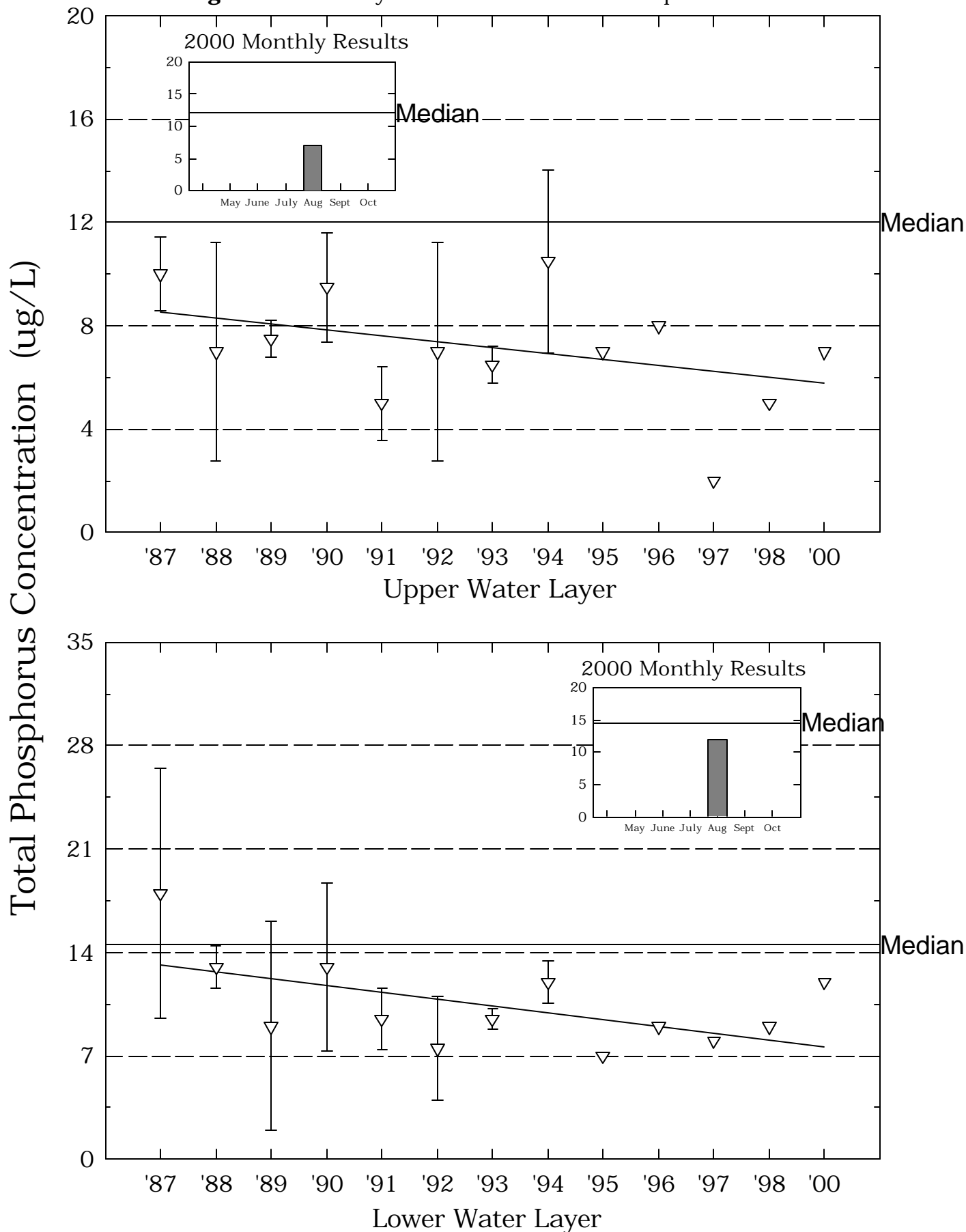


Table 1.**WINNISQUAM, THREE ISL.****LACONIA**

**Chlorophyll-a results (mg/m³) for current year and historical
sampling periods.**

Year	Minimum	Maximum	Mean
1987	2.37	3.59	2.98
1988	2.48	2.63	2.55
1989	1.83	1.96	1.89
1990	2.56	2.56	2.56
1991	1.40	1.84	1.62
1992	1.47	2.82	2.14
1993	1.73	2.16	1.94
1994	1.47	1.85	1.66
1995	1.64	1.64	1.64
1996	2.16	2.16	2.16
1997	1.83	1.83	1.83
1998	3.46	3.46	3.46
2000	2.77	2.77	2.77

Table 2.**WINNISQUAM, THREE ISL.****LACONIA****Phytoplankton species and relative percent abundance.****Summary for current and historical sampling seasons.**

Date of Sample	Species Observed	Relative % Abundance
07/02/1987	TABELLARIA	41
06/30/1988	ASTERIONELLA	41
	DINOBRYON	33
	TABELLARIA	19
07/14/1989	DINOBRYON	49
	ASTERIONELLA	
	STAURASTRUM	
07/05/1990	TABELLARIA	35
	DINOBRYONA	26
	ASTERIONELLA	19
07/01/1992	ASTERIONELLA	62
	TABELLARIA	20
07/01/1993	ASTERIONELLA	35
	TABELLARIA	20
	DINOBRYON	24
07/20/1994	DINOBRYON	36
	TABELLARIA	26
	STAURASTRUM	14
08/17/1994	CHRYSOSPHAERELLA	51
	FRAGILARIA	11
	STAURASTRUM	6
08/15/1995	CHRYSOSPHAERELLA	23
	DINOBRYON	18
	STAURASTRUM	10
08/16/1996	BLUEGREEN SPP	41
	TABELLARIA	28
	DINOBRYON	11
08/14/1997	CHRYSOSPHAERELLA	53
	DINOBRYON	23
	STAURASTRUM	9

Table 2.

WINNISQUAM, THREE ISL.

LACONIA

Phytoplankton species and relative percent abundance.

Summary for current and historical sampling seasons.

Date of Sample	Species Observed	Relative % Abundance
08/13/1998	ASTERIONELLA	36
	APHANIZOMENON	28
	CHRYSOSPHAERELLA	16
08/18/2000	CHRYSOSPHAERELLA	39
	SYNURA	23
	CERATIUM	14

Table 3.
WINNISQUAM, THREE ISL.
LACONIA

**Summary of current and historical Secchi Disk
transparency results (in meters).**

Year	Minimum	Maximum	Mean
1987	5.5	7.0	6.2
1988	7.2	8.0	7.6
1989	7.5	8.0	7.7
1990	5.5	7.0	6.2
1991	6.5	7.5	7.0
1992	8.7	9.0	8.8
1993	7.5	8.0	7.7
1994	9.0	9.5	9.2
1995	8.5	8.5	8.5
1996	7.6	7.6	7.6
1997	7.7	7.7	7.7
1998	7.8	7.8	7.8
2000	8.7	8.7	8.7

Table 4.**WINNISQUAM, THREE ISL.
LACONIA****pH summary for current and historical sampling seasons.
Values in units, listed by station and year.**

Station	Year	Minimum	Maximum	Mean
COLLINS BK	1987	6.70	6.70	6.70
	1988	6.88	6.88	6.88
	1989	6.95	7.03	6.99
	1990	7.03	7.03	7.03
	1991	6.90	6.98	6.94
	1992	6.93	7.03	6.98
	1993	6.73	6.91	6.81
	1994	6.90	6.90	6.90
	1995	6.37	6.37	6.37
	1996	6.78	6.78	6.78
	1997	6.73	6.73	6.73
	1998	6.92	6.92	6.92
	2000	6.81	6.81	6.81
EPILIMNION	1987	6.99	7.22	7.09
	1988	6.95	7.03	6.99
	1989	7.10	7.12	7.11
	1990	7.15	7.15	7.15
	1991	7.17	7.20	7.18
	1992	6.70	7.05	6.84
	1993	6.97	7.02	6.99
	1994	7.04	7.08	7.06
	1995	6.86	6.86	6.86
	1996	6.76	6.76	6.76
	1997	7.24	7.24	7.24
	1998	6.97	6.97	6.97

Table 4.

**WINNISQUAM, THREE ISL.
LACONIA**

**pH summary for current and historical sampling seasons.
Values in units, listed by station and year.**

Station	Year	Minimum	Maximum	Mean
GOV. PARK BEACH	2000	6.98	6.98	6.98
	1997	7.02	7.02	7.02
	1998	7.05	7.05	7.05
GOV. PARK STREAM	1997	7.13	7.13	7.13
	1998	7.34	7.34	7.34
	1999	7.34	7.34	7.34
HYPOLIMNION	1987	6.57	6.60	6.58
	1988	6.33	6.49	6.40
	1989	6.50	6.57	6.53
	1990	6.76	6.76	6.76
	1991	6.80	6.96	6.87
	1992	6.65	6.88	6.75
	1993	6.65	6.73	6.69
	1994	6.58	6.84	6.69
	1995	5.98	5.98	5.98
	1996	6.32	6.32	6.32
	1997	6.52	6.52	6.52
	1998	6.40	6.40	6.40
	2000	6.44	6.44	6.44
	2001	6.44	6.44	6.44
METALIMNION	1987	6.82	6.98	6.89
	1988	6.62	6.76	6.68
	1989	6.66	6.90	6.76

Table 4.

**WINNISQUAM, THREE ISL.
LACONIA**

**pH summary for current and historical sampling seasons.
Values in units, listed by station and year.**

Station	Year	Minimum	Maximum	Mean
	1990	7.25	7.25	7.25
	1991	7.13	7.20	7.16
	1992	6.78	7.20	6.94
	1993	6.87	6.96	6.91
	1994	6.92	7.00	6.96
	1995	6.24	6.24	6.24
	1996	6.33	6.33	6.33
	1997	6.93	6.93	6.93
	1998	6.55	6.55	6.55
	2000	6.95	6.95	6.95
MILL BK	1987	6.24	6.27	6.25
	1988	6.36	6.36	6.36
	1989	6.23	6.31	6.27
	1990	6.37	6.37	6.37
	1991	6.37	6.40	6.38
	1992	6.37	6.55	6.45
	1993	6.11	6.52	6.27
	1994	6.54	6.54	6.54
	1995	6.50	6.50	6.50
	1996	6.10	6.10	6.10
	1997	6.30	6.30	6.30
	1998	6.12	6.12	6.12
	2000	6.25	6.25	6.25

Table 5.**WINNISQUAM, THREE ISL.****LACONIA****Summary of current and historical Acid Neutralizing Capacity.****Values expressed in mg/L as CaCO₃.****Epilimnetic Values**

Year	Minimum	Maximum	Mean
1987	6.80	6.80	6.80
1988	4.80	7.20	6.00
1989	6.60	6.60	6.60
1990	6.70	7.00	6.85
1991	6.80	7.20	7.00
1992	4.80	7.70	6.25
1993	6.30	7.60	6.95
1994	5.40	7.50	6.45
1995	7.70	7.70	7.70
1996	7.50	7.50	7.50
1997	6.20	6.20	6.20
1998	6.70	6.70	6.70
2000	7.30	7.30	7.30

Table 6.

**WINNISQUAM, THREE ISL.
LACONIA**

**Specific conductance results from current and historic
sampling seasons. Results in uMhos/cm.**

Station	Year	Minimum	Maximum	Mean
COLLINS BK	1987	66.0	66.0	66.0
	1988	71.5	71.5	71.5
	1989	89.6	92.0	90.8
	1990	86.6	90.0	88.3
	1991	70.4	73.5	71.9
	1992	77.3	77.7	77.5
	1993	77.3	88.2	82.7
	1994	80.2	80.2	80.2
	1995	85.1	85.1	85.1
	1996	73.3	73.3	73.3
	1997	77.2	77.2	77.2
	1998	80.9	80.9	80.9
	2000	105.3	105.3	105.3
EPILIMNION	1987	63.6	65.8	64.7
	1988	68.6	69.6	69.1
	1989	66.9	68.3	67.6
	1990	71.4	72.2	71.8
	1991	70.1	72.8	71.4
	1992	73.7	74.4	74.0
	1993	74.8	76.6	75.7
	1994	74.9	78.6	76.7
	1995	79.7	79.7	79.7
	1996	73.0	73.0	73.0
	1997	71.4	71.4	71.4
	1998	66.6	66.6	66.6

Table 6.

**WINNISQUAM, THREE ISL.
LACONIA**

**Specific conductance results from current and historic
sampling seasons. Results in uMhos/cm.**

Station	Year	Minimum	Maximum	Mean
GOV. PARK BEACH	2000	81.2	81.2	81.2
	1997	79.3	79.3	79.3
	1998	72.1	72.1	72.1
GOV. PARK STREAM	1997	281.3	281.3	281.3
	1998	265.9	265.9	265.9
HYPOLIMNION	1987	62.9	66.1	64.5
	1988	66.9	69.8	68.3
	1989	73.0	73.5	73.2
	1990	73.3	87.8	80.5
	1991	70.1	70.5	70.3
	1992	70.1	75.6	72.8
	1993	76.2	76.4	76.3
	1994	77.3	79.2	78.2
	1995	75.3	75.3	75.3
	1996	76.9	76.9	76.9
	1997	73.1	73.1	73.1
	1998	75.6	75.6	75.6
	2000	82.3	82.3	82.3
METALIMNION	1987	62.1	66.3	64.2
	1988	69.2	70.0	69.6
	1989	68.9	70.7	69.8
	1990	72.1	73.2	72.6

Table 6.

**WINNISQUAM, THREE ISL.
LACONIA**

**Specific conductance results from current and historic
sampling seasons. Results in uMhos/cm.**

Station	Year	Minimum	Maximum	Mean
	1991	69.4	73.2	71.3
	1992	71.3	76.2	73.7
	1993	74.8	75.4	75.1
	1994	76.6	77.4	77.0
	1995	76.4	76.4	76.4
	1996	75.8	75.8	75.8
	1997	71.7	71.7	71.7
	1998	72.5	72.5	72.5
	2000	81.3	81.3	81.3
MILL BK	1987	59.0	105.7	82.4
	1988	100.9	100.9	100.9
	1989	109.9	122.5	116.2
	1990	50.6	97.9	74.2
	1991	89.5	90.5	90.0
	1992	88.8	90.6	89.7
	1993	84.2	99.2	91.7
	1994	79.5	79.5	79.5
	1995	84.8	84.8	84.8
	1996	72.5	72.5	72.5
	1997	112.4	112.4	112.4
	1998	89.8	89.8	89.8
	2000	94.8	94.8	94.8

Table 8.**WINNISQUAM, THREE ISL.****LACONIA**

**Summary historical and current sampling season Total
Phosphorus data. Results in ug/L.**

Station	Year	Minimum	Maximum	Mean
COLLINS BK	1987	19	19	19
	1988	< 1	9	5
	1989	16	30	23
	1990	24	27	25
	1991	8	9	8
	1992	6	18	12
	1993	10	24	17
	1994	11	11	11
	1995	16	16	16
	1996	8	8	8
	1997	5	5	5
	1998	13	13	13
	2000	9	9	9
EPILIMNION	1987	9	11	10
	1988	4	10	7
	1989	7	8	7
	1990	8	11	9
	1991	4	6	5
	1992	4	10	7
	1993	6	7	6
	1994	8	13	10
	1995	7	7	7
	1996	8	8	8
	1997	2	2	2

Table 8.

WINNISQUAM, THREE ISL.

LACONIA

Summary historical and current sampling season Total
Phosphorus data. Results in ug/L.

Station	Year	Minimum	Maximum	Mean
	1998	5	5	5
	2000	7	7	7
GOV. PARK BEACH				
	1997	5	5	5
	1998	7	7	7
GOV. PARK STREAM				
	1997	49	49	49
	1998	128	128	128
HYPOLIMNION				
	1987	12	24	18
	1988	12	14	13
	1989	4	14	9
	1990	9	17	13
	1991	8	11	9
	1992	5	10	7
	1993	9	10	9
	1994	11	13	12
	1995	7	7	7
	1996	9	9	9
	1997	8	8	8
	1998	9	9	9
	2000	12	12	12
METALIMNION				
	1987	7	14	10
	1988	< 1	11	6
	1989	6	13	9

Table 8.**WINNISQUAM, THREE ISL.****LACONIA**

**Summary historical and current sampling season Total
Phosphorus data. Results in ug/L.**

Station	Year	Minimum	Maximum	Mean
	1990	8	10	9
	1991	5	6	5
	1992	7	7	7
	1993	6	9	7
	1994	7	10	8
	1995	6	6	6
	1996	7	7	7
	1997	5	5	5
	1998	5	5	5
	2000	6	6	6
MILL BK	1987	16	41	28
	1988	22	41	31
	1989	22	33	27
	1990	13	18	15
	1991	12	23	17
	1992	21	24	22
	1993	17	23	20
	1994	18	18	18
	1995	7	7	7
	1996	20	20	20
	1997	18	18	18
	1998	22	22	22
	2000	13	13	13

Table 9.
WINNISQUAM, THREE ISL.
LACONIA

Current year dissolved oxygen and temperature data.

Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
August 18, 2000			
0.1	22.1	8.0	91.3
1.0	21.9	8.0	91.2
2.0	21.8	8.0	90.9
3.0	21.8	8.0	91.1
4.0	21.7	7.9	90.3
5.0	21.7	8.0	90.5
6.0	21.6	7.9	90.1
7.0	21.4	7.9	89.8
8.0	21.1	8.1	91.1
9.0	19.5	8.5	92.0
10.0	17.4	8.4	87.3
11.0	14.6	8.0	79.1
12.0	12.0	7.0	65.4
13.0	10.9	6.6	59.6
14.0	10.3	6.2	55.6
15.0	10.0	6.1	54.4
16.0	9.7	6.6	57.8
17.0	9.5	6.4	55.9
18.0	9.4	6.4	55.7
19.0	9.3	6.4	55.8
20.0	9.2	6.2	54.1
21.0	9.3	6.3	54.9

Table 10.
WINNISQUAM, THREE ISL.
LACONIA

Historic Hypolimnetic dissolved oxygen and temperature data.

Date	Depth (meters)	Temperature (celsius)	Dissolved Oxygen (mg/L)	Saturation (%)
July 2, 1987	19.0	8.5	9.1	76.0
June 30, 1988	18.0	8.0	10.0	84.0
July 14, 1989	17.5	8.2	8.5	71.0
July 5, 1990	16.0	8.1	7.8	65.8
August 15, 1991	16.0	10.0	7.9	69.8
July 1, 1992	20.0	7.1	10.5	86.4
July 1, 1993	18.0	8.5	8.9	74.0
July 20, 1994	16.0	9.0	8.3	72.0
August 15, 1995	19.0	8.8	7.1	60.0
August 16, 1996	20.0	8.5	3.6	30.0
August 13, 1998	17.0	10.6	6.1	54.0
August 18, 2000	21.0	9.3	6.3	54.9

Table 11.

**WINNISQUAM, THREE ISL.
LACONIA**

**Summary of current year and historic turbidity sampling.
Results in NTU's.**

Station	Year	Minimum	Maximum	Mean
COLLINS BK	1997	0.3	0.3	0.3
	1998	0.3	0.3	0.3
	2000	0.3	0.3	0.3
EPILIMNION	1997	0.1	0.1	0.1
	1998	0.2	0.2	0.2
	2000	0.2	0.2	0.2
GOV. PARK BEACH	1997	0.3	0.3	0.3
	1998	0.2	0.2	0.2
GOV. PARK STREAM	1997	0.7	0.7	0.7
	1998	1.0	1.0	1.0
HYPOLIMNION	1997	0.3	0.3	0.3
	1998	0.2	0.2	0.2
	2000	0.4	0.4	0.4
METALIMNION	1997	0.1	0.1	0.1
	1998	0.2	0.2	0.2
	2000	0.2	0.2	0.2
MILL BK	1997	0.7	0.7	0.7
	1998	0.6	0.6	0.6

Table 12.

**WINNISQUAM, THREE ISL.
LACONIA**

**Summary of current year bacteria sampling.
Results in counts per 100ml.**

Location	Date	E. Coli
GOV. PARK STREAM		See Note Below
	August 18	210